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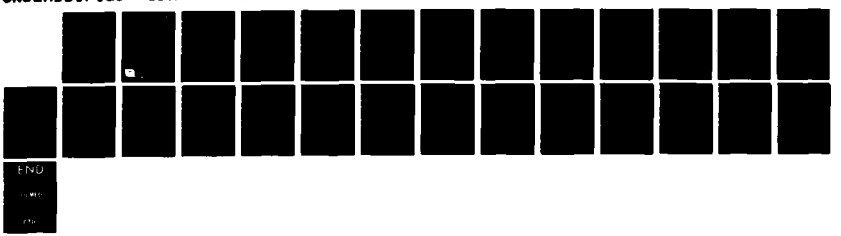

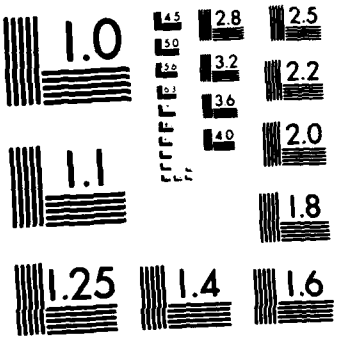

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IDA MEMORANDUM REPORT M-7

CONCEPT PAPER FOR THE DEVELOPMENT OF A DoD Ada* SOFTWARE ENGINEERING EDUCATION AND TRAINING PLAN

Dr. Pauline R. Jordan
Catherine W. McDonald
Brian Schaar

November 1984

Prepared for

Office of the Under Secretary of Defense for Research and Engineering

INSTITUTE FOR DEFENSE ANALYSES

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(Ada Joint Program Office)

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The Ada Joint Program Office (AJPO) was established in December 1980, to manage the Department of Defense (DoD) efforts to implement, introduce, and provide life-cycle support for Ada. As part of this charter, it is the role of the AJPO to address Ada education and training. The goal of this document is to set forth the concepts necessary for Ada software engineering education and training. These concepts will result in an effective use of Ada in

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the shortest time possible to realize cost savings and achieve reliability and adaptability in computer software development. The full potential of Ada cannot be realized without appropriate education and training.

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PREFACE

On 10 June 1983, Dr. Richard D. DeLauer, Under Secretary of Defense (Research and Engineering) stated that "The Ada Programming Language shall become the single, common computer programming language for defense mission-critical applications. Ada shall be the programming language:

- 1 January 1984 for programs entering advanced development, and
- 1 July 1984 for programs entering full-scale engineering development."

In 1984, Congress mandated the accelerated use of Ada in mission critical computer resources.

In order to realize the full potential of Ada, an effective, timely Ada education and training program must be developed. One of the objectives of the Ada Joint Program Office (AJPO) is to coordinate the development of the program. The first step is this concept paper. The next step includes establishing a Tri-Service Working Group and designating a lead service. The working group, the Software Engineering Education Working Group (SEEDWG), will use this concepts document as the framework to prepare and maintain a DoD Ada Software Engineering Education and Training Plan. The responsibilities of this group are outlined in Appendix A.

TABLE OF CONTENTS

1.0 INTRODUCTION:

1.1 PURPOSE: Reduce Life-Cycle Software Development Costs

The Ada* Joint Program Office (AJPO) was established in December 1980, to manage the Department of Defense (DoD) efforts to implement, introduce, and provide life-cycle support for Ada. As part of this charter, it is the role of the AJPO to address Ada education and training. The goal of this document is to set forth the concepts necessary for Ada software engineering education and training. These concepts will result in an effective use of Ada in the shortest time possible to realize cost savings and achieve reliability and adaptability in computer software development. The full potential of Ada cannot be realized without appropriate education and training.

Because one of the main design goals of Ada is to reduce the life-cycle cost of software development, it was developed to support modern software engineering concepts and to become an integral part of a computer programming environment. If Ada education and training fails to address these more global issues, the result will be a use of the Ada language by software designers and computer programmers reflecting only those low-level features already existing in other High Order Languages (HOL's) with which they are familiar. This use of the language would hinder the goal to decrease the cost of software development.

1.2 SCOPE: AJPO/STARS Interface

Ada is the cornerstone of the much broader Software Technology for Adaptable, Reliable Systems (STARS) initiative. Human Resources development has been identified as one of the task areas of the STARS program. The primary objective of the Human Resources task is to increase the level of expertise and expand the base of personnel resources available to the DoD. It logically follows that a DoD Ada Software Engineering Education and Training Plan could become the cornerstone of a much broader education program for software professionals.

To be consistent with the STARS Human Resources development task, a DoD Ada Software Engineering Education and Training Plan should emphasize the Ada language impact on software engineering principles. The introduction of software engineering concepts and the use of an Ada Programming Support Environment (APSE) will impact the way software is developed just as the use of the Ada language itself will effect the way software is designed. First,

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it is anticipated that effective use of Ada will change the emphasis on the amount of effort expended during the various phases of the software life-cycle by increasing front-end analysis and design aspects. Second, the effective use of Ada packages will result in reusable software modules which will strongly influence the software development job skills. Third, the APSE tool set will automate many life-cycle tasks, thus eliminating the need for certain current job skills but requiring the establishment of new skills. Thus, the results of other STARS task groups -- such as Methodologies, Environments and Metrics -- must be integrated into the Ada software engineering education and training program.

1.3 AUDIENCE: Primarily DoD Personnel

As a DoD organization, the Ada software engineering education and training program is directed primarily to the services and DoD agencies responsible for recruiting and training military and civilian personnel. All personnel within the DoD involved with software anytime during its life cycle need some type of training. This will include project managers, software developers, programmers and maintenance personnel. It may also be necessary to introduce the language to recruitment personnel, as well as contract officers and other support personnel. Since software development also involves large numbers of government contractors from private industry, the Ada software engineering education and training program will benefit this audience in training their workforce. Since both DoD and industry personnel rely on the colleges and universities for pre-employment and in-service education and training of their personnel, the academic community is another audience addressed.

Industry and academia, as well as professional computer associations, users' groups, and vendors of Ada education and training, all have much to contribute to implementing Ada education and training, both within the DoD and outside of it. The Ada software engineering education and training program will focus the efforts of all groups by providing a strategy for effective and efficient transition to an Ada culture which results in reliable, adaptable systems while reducing development and maintenance costs.

1.4 METHOD: Public Review and Standardization

The approach of this program will be patterned after the AJPO's efforts in language development, compiler validation, the APSE, and the Common APSE Interface Set (CAIS) design. Although the Ada language development project was sponsored by the DoD, it was subject to public review by interested individuals in industry, academia, and professional societies. ANSI standardization was achieved in February, 1983. The Ada compiler validation followed a similar pattern of development and public review which resulted in required annual certification of compilers and incrementally more complete test sets. The APSE and CAIS projects are currently in development, and government, industry, and academia working groups have been established to review specific areas. It is the intent of the AJPO that Ada education and training should be planned and conducted in a similar fashion. To this end, an Ada Software Engineering Education Working Group (Ada SEEDWG) will be formed. The Ada SEEDWG Charter can be found in Appendix A.

1.5 INSTRUCTIONAL DESIGN: An Evolutionary Model

In classic instructional systems design, an education and training program begins with defining task and skill performance by observing and analyzing the behavior of experts. While the DoD military and civilian software development personnel is an existing productive workforce, their level of experience in using Ada as an implementation language precludes this traditional approach to education and training. In brief, there are no Ada development job models from which to derive an Ada software engineering education and training program. Because of this, the Ada software engineering education and training program must provide for a predetermined evaluation phase. Initial implementation of this program must yield feedback for further improvement. It is important, therefore, that the results of education and training be measured by data collection and analysis as a quality control function of this program. Thus an important aspect of any plan must be the development of the metrics and measurement aspects as well as the education and training itself.

1.6 STRUCTURE: Strategic and Operational Concepts

The Ada software engineering education and training program will involve both Strategic and Operational Concepts. Strategic Concepts will consist of identifying, within the subject matter, what knowledge and skills must be mastered to effectively reduce the life-cycle costs of software development and how to measure when someone has achieved a level of competence for certification. It will define project elements and provide overall budgets, schedules and resource requirements for these areas. Operational Concepts will address the number of personnel to be trained, the degree and priority for the training, the target training locations, and the operational budgets, schedules and required resources to train these people.

The Strategic Concepts are generic and must be updated as experience is gained in Ada development. Among the variable elements in achieving the Ada software engineering education and training program goals are the evolving effects of Ada language features on design methodologies and the additions and upgrades to the tool sets found in the Ada Programming Support Environment (APSE). The Strategic Concepts will be monitored, adapted, and expanded as required by the Ada Software Engineering Education Working Group (Ada SEEDWG) under AJPO management.

The Operational Concepts will be refined by the defense and government agencies responsible for software development as specific needs and organizational structure require. They are also adaptable for use by industrial and academic Ada education groups.

The Strategic and Operational Concepts are explained in detail in the next two sections. Each section is divided into subsections, identifing particular projects/goals necessary for an effective Ada software engineering education and training program. At the end of each subsection, an implementation task is outlined with suggested steps for achieving that project or goal. Much is known about Ada software engineering education and training that can be immediately implemented; much more needs to be learned about Ada and its use.

2.0 STRATEGIC CONCEPTS

The main thrust of the Strategic Concepts is to provide an Ada software engineering education and training approach. The AJPO is concerned with the development of policy and procedures to maximize course development resources, to disseminate information to the DoD community, and to promote shared education and training resources within the DoD.

To these ends, the AJPO will

(1) establish general Ada information services

(2) centralize and disseminate Ada education and training materials to the DoD

(3) study Ada development projects for measurable education and training data

(4) provide for the timely transfer of Ada education and training data

(5) develop guidance for certifying competency of DoD software professionals

2.1 INFORMATION SERVICE

Current AJPO-sponsored publications include the Ada Information Clearinghouse (IC) Newsletter and the Catalog of Resources in Education for Ada and Software Engineering (CREASE). The Ada IC Newsletter updates all AJPO activities: compiler validation, methodology study plan, APSE evaluation, CAIS development, etc.; while the CREASE disseminates information on Ada software engineering educational sources without review or endorsement. Both of these publications serve an audience actively involved in Ada. Also, accessible to people with ARPANET or Telenet accounts, there is an Ada-Information account on the AJPO-sponsored computer located at the USC Engineering Computer Lab (ECLB). This database provides information on various topics including data on AJPO personnel, validated Ada compilers, outlines of courses and seminars on Ada, Ada textbooks, and where to obtain other materials.

In addition to these reference services, AJPO has initiated a video tape library through the Defense Audio Visual Agency (DAVA). Ada related video instruction and/or information tapes can be obtained by the government agencies through established acquisition procedures. As with CREASE, no attempt has been made to endorse the technical or instructional aspects of these videotape materials.

Government personnel with ARPANET accounts can also access an Ada compiler for experimental hands-on instructional purposes. This resource has the potential to provide compiler access to many start-up programs unable to justify the cost of computer facilities for Ada training.

All of these AJPO projects--the Ada IC Newsletter, CREASE, ARPANET information, the DAVA tape library, and the Ada compiler access--provide DoD, as well as others interested in Ada, with a much needed information service. However, there is a much larger software development population unaware or unable to utilize these services. Both groups, those actively involved in the Ada effort and those not, need additional information on how a standardized language will reduce costs and increase software reliability and adaptability. The AJPO is actively seeking additional alternatives to answering the basic question: "What is Ada and why should I be interested in it?"

Depending on the target audience, this can be done in a relatively straightforward manner. The important message is what Ada features--such as modularity, abstraction, and information hiding--accomplish and what problems they solve relative to the job needs of a particular individual. The objective is to change the model of software design, development, and maintenance acquired from previous language experience. For example, in the defense sector, the library sub-program (of FORTRAN, JOVIAL and CMS-2) has been the unit of decomposition since it is available in these primary languages; in contrast, the Ada package is a key concept which requires the designer to develop a new design decomposition methodology. The impact is that an Ada Information Service should provide a better understanding of software engineering and its proper use, i.e. rather than an understanding of Ada package construction, package architecture must be emphasized. Another objective of the Ada Information Service is to counter the misconception that Ada is "just another language." The Service should avoid courses with hands-on exercises since these tend to emphasize minor software design details rather than effective use of Ada. Code should be read and modified rather than generated and compiled for syntax errors.

2.1.1 IMPLEMENTATION TASK: Develop an Ada Information Service

- 2.1.1.1 Write measurable performance outcomes of audience/s using the service
- 2.1.1.2 Analyze and document target audience/s characteristics
- 2.1.1.3 Establish content of the service
- 2.1.1.4 Select delivery method/s for the service
- 2.1.1.5 Develop the service
- 2.1.1.6 Implement the service
- 2.1.1.7 Collect, analyze and report cost/benefit data on the Ada information service

2.1.2 Evaluate on-going Ada information activities

- 2.1.2.1 Ada Information Clearinghouse Newsletter
- 2.1.2.2 Catalog of Resources for Education in Ada and Software Engineering
- 2.1.2.3 Videotape library resource (DAVA)
- 2.1.1.4 Online ARPANET Ada database
- 2.1.1.5 ARPANET Ada compiler

2.1.1.6 Collect, analyze, and report cost/benefit data of on-going AJPO information services

2.2 ADA COURSE DISSEMINATION

A need exists for Ada software engineering education and training not only for programmers, but for all personnel in development and management of software, as well as support groups in personnel, finance, contracts, etc. Several courses are currently offered by Army and Air Force organizations for a diversified audience. However, these course materials are not readily available to other DoD personnel. Therefore, it is desirable that the AJPO provide a centralized source of Ada software engineering education and training materials. The benefits include eliminating duplication of development efforts and accelerating education and training for start-up programs.

2.2.1 IMPLEMENTATION TASK: Centralize and disseminate Ada software engineering course materials

- 2.2.1.1 Survey existing courses in DoD
- 2.2.1.2 Identify courses by appropriate target audiences, learning objectives, delivery methods, etc.
- 2.2.1.3 Establish review and sourcing procedures
- 2.2.1.4 Publicize program
- 2.2.1.5 Collect, analyze, and report cost/benefit data of Ada course dissemination program

2.3 ADA STUDY PROJECTS

The above mentioned Ada Information Service and Ada software engineering course dissemination are based on what is known about Ada. While it is important that software developers understand these principles, they do not translate directly into software engineering skills. Until Ada training and education is measured against job performance and product quality, there is no data to measure instructional effectiveness. Study projects will give the Ada software engineering education and training program a platform of reality.

Already, several Ada development projects have been conducted by the DoD and there are several currently on-going. There is a need to collect and analyze data on these projects relative to education and training. We need to know what instructional techniques were used and if these proved to be valuable or not. Ada software engineering education and training based on such study projects will have more credibility than education and training programs which have no verification of their effectiveness. Although costly and time-consuming, study projects need to be initiated immediately. They will answer essential questions on technology transfer so vitally needed for wide-spread use of Ada and attainment of the goals of the STARS program.

2.3.1 IMPLEMENTATION TASK: Conduct Ada Study Projects.

2.3.1.1 Collect, analyze, and report education and training data for on-going and completed Ada development projects
2.3.1.2 Write data collection criteria for eduction and training in future Ada development projects
2.3.1.3 Establish an on-going program to support data collection, analysis, and reporting on Ada development projects

2.4 ADA EDUCATION AND TRAINING TECHNOLOGY TRANSFER

As individual defense and government agencies embark on the use of Ada, it is anticipated that valuable experience within the groups will be generated. In order to provide a timely transfer of this new technology, the AJPO will coordinate these activities and provide a base of shared materials and methods in Ada education and training. The Ada information, course dissemination, and study project tasks need to be implemented quickly and widely to accelerate the effective use of Ada. These programs will yield field test data that must be analyzed and reported to improve the programs. Existing efforts may be duplicated because an identified common resource for Ada education and training is unknown. An Ada software engineering education and training technology transfer function will provide a variety of tried and tested programs to those responsible for Ada education and training. This rich experiential database can eliminate repetition of costly efforts on the part of segmented groups and accelerate the transfer of new technologies into software development.

Another reason to institutionalize Ada education and training technology transfer lies in the coordination of the AJPO efforts with the STARS program. As research efforts in each of the STARS task areas yields new technology for achieving adaptable, reliable software, an ensuing education and training program must be developed. These education and training programs must be developed concurrent with other STARS work in measurement, methodology, automated software factory, acquisition/project management, application specific and human resources.

2.4.1 IMPLEMENTATION TASK: Develop an Ada education and training technology transfer program.

2.4.1.1 Establish a shared data base of Ada education and training experiences
2.4.1.2 Provide modularized education and training materials in a variety of formats.
2.4.1.3 Integrate education and training with emerging software engineering technologies

2.5 CERTIFY COMPETENCY OF ADA SOFTWARE PROFESSIONALS

In order to ensure that the courses and materials available produce competent Ada software professionals, steps should be taken to introduce a method of certifying these professionals. One possibility may be to incorporate certification of Ada software expertise with the Certificate in Computer Programming examination given by the Institute for the Certification of Computer Professionals (ICCP). The CCP presently tests professionals in three areas of specialization - Business Programming, Scientific Programming, and Systems Programming. The Ada software engineering education and training program should investigate the feasibility of introducing a fourth area of specialization - Ada Programming Using Software Engineering Concepts. Another possibility would be to investigate the inclusion of software engineering with Ada in each of the present areas of specialization. Other methods of certifying the competency of Ada software professionals should also be investigated.

2.5.1 IMPLEMENTATION TASK: Investigate ways to certify Ada software professionals.

- 2.5.1.1 Explore ICCP Computer Programming examination to include certification of Ada software professionals
- 2.5.1.2 Investigate other possible certification exams
- 2.5.1.3 Investigate possibility of DoD developing their own certification exam for Ada software professionals

3.0 OPERATIONAL CONCEPTS

Earlier in this plan (2.1) we addressed the need to change the conceptual model of software development acquired from previous language and software engineering experiences. In addition, and perhaps even more important, we need to change the model of how software engineering education and training is conducted within the DoD. Typically we approach planning for education and training with two fixed parameters: time and budget. Without first establishing performance based learning outcomes or specifying characteristics of the target audience, we predetermine that only so much time or so much money will be expended. These latter--the "what" and "who"-- determine all the other variables of conducting education and training such as "when, where, and how?"

3.1 WHAT: COURSE CONTENT

The Strategic Concepts address (1) Ada Information Service, (2) Ada Course Dissemination, (3) Ada Study Projects, (4) Technology Transfer, and (5) Certification. The first two, Ada information and course dissemination, can be expected to meet short term needs for a broad base of software developers in the managerial, technical and support areas. The latter three, Ada study projects, technology transfer, and certification, are long term projects. The decisions on what to teach to a specific audience embrace both the short and long term strategies.

The sophistication, size, and cost of DoD and many other software systems demand an orderly and accountable development procedure. Government procurers and their contractors have standardized these sequential steps in what is most commonly referred to as the software life cycle. Its essential phases are system requirements engineering, resource allocation, software requirements engineering, preliminary design, detailed design, program development, software integration, system integration, testing, and operations/maintenance. Each sequential phase of the life cycle must be evaluated in terms of what skills are required for effective use of Ada.

In matching this life cycle skill matrix with the Ada knowledge domain, attention must be given to prioritizing the instruction required. For example, while programming skills are important, it is highly unlikely that you can get a good program from a bad design, no matter how competent the Ada programmer working on it may be. To go one step further, you can not get a good design until you document the requirements. In the long term, teaching Ada separate from a software engineering discipline may become obsolete with the advent of reusable software, code generators and other automated tools. As discussed in Ada Study Projects (2.3) we do not yet know Ada's total effect on the software life cycle in terms of job skills. However, we do know that Ada embodies software engineering principles which transcend the language itself.

3.1.1 IMPLEMENTATION TASK: Allign Ada course modules with life cycle skills

3.2 WHO: TARGET AUDIENCE

While it may be easier to teach people who know nothing and have plenty of time, the reality is that the vast majority of DoD personnel to be educated and trained in Ada are working professionals whose schedules, experiences, and learning styles must be accommodated. In this sense we are dealing with the re-education of teams of software developers in the managerial, technical and support areas.

Currently, in most organizations we find the extreme ends of the normal distribution curve--the philics and phobics--those who either intensely love or intensely fear Ada. But it is the wide group in the middle that is more characteristic of the typical audience to be trained. Most of these are competent computer professionals who have already mastered several new languages using a textbook, reference manual, and hands-on experiences. Most will not be able to attend extended classes because of limited labor budgets for training. A typical DoD or industry course is one or two weeks in length after which the learner returns to his/her organization to train others on the job. Few of these professionals will be able to learn the effective use of Ada and its role in software engineering this way.

We must also recognize that for some technical managers, the investment in becoming highly skilled in a complex language, such as Ada, may not be justified in terms of their career potential. Certain managers do not need to have total command of a programming language; however, it is necessary that they understand the major features of the language and specific software engineering concepts. This need to know is especially relevant in preparing statements of work, RFPs, etc.

People must use the language to appreciate its new features. Currently only 10% of any language--not always the same 10%--is consistently used in program development. The easier parts of Ada can be learned quickly; the harder parts in a reasonable time. However, understanding the interaction between some parts of the Ada language requires hands-on experience. This is referred to as the cross construct implications which make it extremely difficult to use the more advanced aspects of the language well.

These examples of the target audience are broad in the extreme. While the generalities inferred from these examples are probably true, we need to learn much more about specific target audiences: current skills, attitudes, and work constraints. All these will influence Ada education and training on the operational level.

3.2.1 IMPLEMENTATION TASK: Develop target audience profiles.

- 3.2.1.1 Survey current working professionals' skills, attitudes, and work constraints
- 3.2.1.2 Apply Ada Study Project audience data
- 3.2.1.3 Incorporate audience profiles into technology transfer database

3.2.1.4 Disseminate information to DoD agencies/services doing operational planning

3.3 WHEN: SCHEDULING ADA EDUCATION AND TRAINING

Teaching Ada culture will be a long term activity. Unless we are willing to accept programming in Ada using restrictive software engineering concepts such as those found in FORTRAN, JOVIAL, or CMS-2 we need a lengthy period for Ada education and training. There are several estimates among Ada instructors and users on how long it takes to properly teach an Ada software engineering culture. These estimates range from three to eighteen months full-time equivalency including the opportunity to use the language. One study indicates it takes six months in the best environment with access to a compiler, Ada code to read, and experienced Ada developers available for ad hoc consultation. Others estimate the learning period as high as three to five years to become fully proficient in Ada software engineering. The actual time will be highly dependent on the student's capability, the background, the life cycle skills, and the competency desired.

Experienced Ada instructors divide learning into two categories: course time of five to ten days; and practice time, which depends on the learner's ability, previous experience, and motivation. Teaching the five to ten day course will result in knowing <u>about</u> Ada and parallels what was described earlier as Ada information. However, the practice time requires hands-on access to a compiler to actually have realtime exposure to concepts such as cross construct implications and use of packages. People who do not use the language cannot appreciate its new features. Experience is still the best teacher.

It must be noted, from experience in teaching Ada as well as other subjects, that it takes more than one exposure to a new concept to learn it. Teaching and learning are two different things. Because we say it does not mean the learners hear it. They listen through the filter of their own individual mind sets. Another universal learning principle that applies is that knowledge not used will, over time, be forgotten. Therefore, the time after a formal course is important for phasing classroom with practice.

All of these considerations impact operational concepts in terms of scheduling Ada education and training. As the Ada study projects further our knowledge of training's relation to performance, scheduling training should become more effective.

3.3.1 IMPLEMENTATION TASK: Develop scheduling guidelines.

3.3.1.1 Survey and evaluate effectiveness of current practices
3.3.1.2 Sequence course and practice activities
3.3.1.3 Provide for self paced remediation/acceleration capabilities
3.3.1.4 Incorporate scheduling in technology transfer database

3.3.1.5 Disseminate information to DoD agencies/services doing operational planning

3.4 WHERE: LOCATION OF ADA EDUCATION AND TRAINING

The answer to where for Ada education and training is simply--everywhere. A plethora of training facilities for software professionals exist which can accommodate Ada education and training. These include, but are not limited to:

- o Service Academies
- o Universities and Colleges
- o Service/Agency Classroom Environments

Special mention should be made of the Software Engineering Institute (SEI) as a potential location for Ada education and training. The SEI can ensure that education and training are developed parallel with emerging technologies to accelerate the goals of the STARS program.

3.4.1 IMPLEMENTATION TASK: Identify and coordinate agencies/services' training facilities for Ada software engineering.

- 3.4.1.1 Document current facilities
- 3.4.1.2 Facilitate incorporation of Ada in appropriate curricula
- 3.4.1.3 Incorporate facilities in technology transfer database
- 3.4.1.4 Disseminate information to DoD agencies/services doing operational planning

3.5 HOW: DELIVERY METHODS

If a mind set exists anywhere in education and training, it exists in our model of how we learn. Essentially this is the classroom experience acquired from years of institutionalized learning. The key variable is the instructor, an invaluable, but limited, resource. We must face the problem of instructor training if we elect to use classroom teaching as a delivery method.

The restrictive factors of trainees' labor, travel and living costs have led to the use of videotaped instruction. The trade-off for lower course delivery cost is the loss of opportunity to respond to learners' questions and the inability of the instructor to tailor the course content to specific audiences. Because of our frequent exposure to professional television, it is often the case that instructional videotapes fail to meet our level of expectation of the medium. In many instances they have been low budget productions produced by those inexperienced with the medium. We must compensate for these deficiencies in videotapes to maximize the use of this delivery method.

The need for hands-on practice, along with formal instruction, has led to the development of several Ada education and training products using computer based education as a delivery method. In some cases this method is combined with formal classroom instruction and/or textbook reading. This delivery method is structured to provide mastery learning, corrective feedback, and self-paced instruction. In using this delivery method, sufficient hardware must be available to the learner for problem solution and compilation. This initial capital investment, although amortized, is a restrictive factor for some organizations. A second factor in computer-based education is the motivation of the learner. Usually the trainee works in an independent mode and may need the help of a knowledgeable reference or human resource that is unavailable at the time. This learning method is unlike previous learning experiences. While the computer professional is adept at using the terminal, there is still the acceptance of learner-directed instruction that must be assimilated.

Other delivery methods such as programmed instruction, audiotapes, satellite broadcast with two way audio, and on-the-job automated learning aids are other delivery methods to be considered. The variables of time and cost must be calculated in evaluating trade-offs among available methods. Since learner preference is an important variable, it is reasonable to offer a variety of delivery methods.

3.5.1 IMPLEMENTATION TASK: Document requirements, advantages, and costs of delivery methods

- 3.5.1.1 Instructor led classroom courses
- 3.5.1.2 Videotaped courses
- 3.5.1.3 Computer-based instruction
- 3.5.1.4 Satelitte broadcast courses
- 3.5.1.5 Programmed instruction
- 3.5.1.6 Audiotapes/text
- 3.5.1.7 Combinations of delivery methods
- 3.5.1.8 Incorporate delivery methods in technology transfer database
- 3.5.1.9 Disseminate information to DoD agencies/services doing operational planning

4.0 SUMMARY

The AJPO recognizes that education and training is an essential part of its charter to implement, introduce and provide life cycle support of Ada. While significant, on-going activities currently exist within the AJPO and the Services, a DoD Ada Software Engineering Education and Training Plan initiated by a Tri-Service Ada Software Engineering Education Working Group (Ada SEEDWG) is necessary to provide a broader, more coordinated program. This program will accelerate the effective use of Ada in the shortest time possible to improve software quality and subsequently decrease software development costs.

This paper provides for the development and implementation of an Ada information service and Ada course dissemination. Clearly these activities will not result in Ada experts, but will familiarize the software community with the language and its potential benefits. Through the initiation of Ada Study Projects further information can be provided relevant to emerging life cycle skills resulting from the effective use of Ada. The technology transfer program will establish a shared data base of Ada education and training to provide agencies and services assistance in operational planning. By certifying the competency of Ada software professionals, the quality of available Ada programmers/software engineers will be improved.

The purpose of this concepts document is to maximize the synergism of education and training efforts of the services, agencies, industry and academia. Through the efforts of the Ada SEEDWG, required specification for standardization and certification of education and training will be defined. The initial efforts of the Ada SEEDWG should be directed to implementing, monitoring and modifying a DoD Ada Software Engineering Education and Training Plan.

APPENDIX A

Charter of the Ada Software Engineering Education Working Group

Purpose

The purpose of the Ada Software Engineering Education Working Group (SEEDWG) shall be to support OUSDRE(R&AT)/AJPO in formulating policy and guidance which ensures that quality software engineering is accomplished through Ada education and training with the DoD in order to reduce the life cycle cost of software.

Membership

The SEEDWG will be chaired by a lead service agency reporting to the AJPO. The membership of the SEEDWG shall be composed of representatives designated by each service and other DoD agencies as appropriate. Members should be qualified to adequately represent the Ada technical community and the education and manpower/personnel/training (MPT) communities.

Urgency of Need

Congress has mandated the accelerated use of Ada in mission critical computer resources. The full potential of Ada can only be realized through effective, timely Ada education and training.

Scope of Responsibilities

The main responsibility of the SEEDWG is to prepare and maintain a DoD Ada Software Engineering Education and Training Plan. The framework for the SEEDWG is the draft "Concept Paper for the Development of a DoD Ada Software Engineering Education and Training Plan" of 26 October 1984. Additional responsibilities of the SEEDWG will include:

(a) Defining the target audience
(b) Establishing both learning objectives and curriculum guidance
(c) Promoting common course module development to maximize resources
(d) Establishing an Ada Certification Program
(e) Promoting evaluation/feedback on course adjustments to facilitate learning objectives and to establish a lessons learned forum
(f) Providing resource recommendations to the AJPO

Any documentation from this working group shall be subject to review and approval by the services and agencies.

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